

An Assessment of
Anadromous Fish Habitat Use
and Fish Passage Above
Makah National Fish Hatchery in
the Sooes River

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INTRODUCTION

This report was funded by the “Puget Sound and Coastal Washington Hatchery Reform Project.” The goals of the hatchery reform project are to “conserve indigenous genetic resources, assist with the recovery of naturally spawning populations, provide for sustainable fisheries, conduct scientific research, and improve the quality and cost-effectiveness of hatchery programs” (Gorton Science Advisory Team 1999).

This report presents options and recommendations regarding anadromous fish use of the habitat above the Makah National Fish Hatchery (NFH) in the Sooes River. Makah NFH presently blocks anadromous fish access to at least 10.8 miles of mainstem river and to at least 14 miles of tributaries. Restoration of anadromous fish access to the Sooes River watershed is consistent with the goals of the hatchery reform project.

This work also supports several goals of the U.S. Fish and Wildlife Service (Service). The Service adopted an ecosystem approach to resource management several years ago. Teams were established within the North Pacific Coast Ecoregion to discuss and identify ecosystem concerns and possible corrective actions for implementation. Salmon use of stream habitat above human-caused impasses (fish hatchery weirs, for example), surfaced as a priority concern during a North Pacific Coast Ecoregion meeting in August of 1999.

Fish passage improvement has also been identified as a priority effort within the work activity guidance in the Region I Fisheries Program (Diggs 2002). The program guidance specifically states that NFHs are to give “high priority to identifying and correcting fish passage problems.”

In addition to the Region I program, a national “Fish Passage Program” is being developed (Service 2000). The national program goal is to “Restore native fish and other aquatic species to self-sustaining levels by reconnecting historical habitats and re-establishing watershed function through removal of, or passage around man-made barriers.”

While the topic of habitat use above our National Fish Hatcheries is currently receiving regional and national attention, it is not a new subject for the Makah NFH Hatchery Evaluation Team. This team consists of staff from Makah NFH, the Olympia Fish Health Center, and the Western Washington Fish and Wildlife Office. The team continues to discuss and direct hatchery operations, including use of stream habitat above the hatchery.

This report assumes no changes to current hatchery production with recommendations discussed herein, because of management constraints described throughout. Also, no harvest management changes will be proposed as a result of this report.

OBJECTIVES OF RESTORED SALMON USE

An objective of restoring salmon access to streams that are either void of or under-seeded regarding salmon populations is to optimize fish production from the freshwater environment where humans have created impasses to salmon migration. Historically, this effort was directed primarily towards hatchery programs that were initiated to mitigate for declining wild populations and lost harvest opportunities. Ironically, in many cases this caused a further decline in wild populations since they could not be separated from abundant hatchery stocks in the harvest areas and were subsequently over-harvested. Recently, listings of several populations of salmon under the Endangered Species Act have resulted in closed fisheries or changes in harvest methods. These changes are designed to allow weak populations access to freshwater habitats for spawning. In streams where wild populations are not threatened by hatchery stocks, making additional freshwater habitat available to salmon may result in increased salmon production and subsequent increased contributions to commercial and sport fisheries.

Another objective is to restore some level of “natural selection” pressures if we allow anadromous fish to use the available habitat. In the process of evolution, natural selective forces have chosen the combination of traits that will best enable organisms to survive in their natural environment. These traits may or may not be apparent to us, but we know that unique combinations of genes develop in response to specific environmental influences (Hershberger and Iwamoto 1983). Some scientists believe that hatchery fish have been genetically altered as a result of many years of human selection of matings, stocks, run timing, and other fish cultural practices (Reisenbichler and Rubin 1999). These authors argue that artificial propagation results in significant genetic change which lowers fitness. Fitness in this case refers to the ability to naturally propagate.

A third objective is to enhance stream productivity through nutrient enrichment. As carcasses decompose, they provide a significant amount of the nutrients that are incorporated into the stream food web (Kline et al. 1990; Bilby et al. 1996). Carcasses are a direct food source for juvenile salmonids. Also, many salmonid carcasses are hauled out of streams for consumption by terrestrial animals and subsequent nutrient cycling through the terrestrial system (Cedarholm et al. 2000).

PROGRAM MANAGEMENT

The Makah NFH is located on the Sooes River 3 miles above its entrance to the Pacific Ocean (Figure 1). The Makah NFH was established in 1981 to restore salmon resources of the Makah Indian Reservation and nearby watersheds on the north Washington coast and the Strait of Juan de Fuca.

The current fish production program at Makah NFH is consistent with the “operational” plan (Service 1995), a business lease agreement, and several cooperative agreements with the Makah Nation. Modifications to the fish production program are discussed as needed with Makah Tribal representatives. The Washington Department of Fish and Wildlife (WDFW) is not involved with on-reservation fish production. Agreement between the Makah Nation and the Service is required before a change in production can be implemented, as required by the aforementioned plans and management agreements.

Each year’s proposed fish production program is further communicated with the State and Tribal co-managers through the annual Future Brood Document process that includes all Washington hatcheries. This process was originally initiated as a result of the Boldt decision and the court order for the co-managers to communicate fish production activities (Andy Appleby, WDFW, per. comm., 2000). The current production program includes releases of 3.2 million fall Chinook salmon, 250,000 coho salmon, and 175,000 steelhead trout into the Sooes River. The hatchery also transfers 50,000 yearling coho salmon, 100,000 fall Chinook salmon (if available after on-station production needs are met and after 300 adult Chinook are passed upstream), and 25,000 yearling steelhead trout to the Educket Creek (a tributary to Waatch River on the Makah Reservation) facility operated by the Makah Nation. The overall production program, including the species and numbers produced, has remained fairly stable over the last 5 years.

CURRENT FISH PASSAGE PROGRAM

The existing weir was constructed in conjunction with the rest of the facility in the late 1970s and early 1980s. The design consists of probes suspended from an overhead cable and a ground wire in the weir deck. An electrical current is created when water completes an electrical circuit between the probes and the ground wire diverting all fish into the hatchery ladder. The weir is not a physical block to fish movement during a combination of high flow and high tide if it is not electrified. Usually, the weir is de-activated when not needed to divert fish into the hatchery. Generally, it is activated from October to March.

There is no bypass ladder in the weir itself. However, there is a ladder connected to the main hatchery ladder that provides access from the river below the weir to the river above the weir. This ancillary ladder has never been used. A major spawning facility renovation project was completed in 2001. Prior to the project, fish were returned to the Sooes River via pipes leading from the spawning area to the river just upstream of the weir. This system has been modified to include a recovery pond for the fish that are now anaesthetized before handling.

Active passage of adult salmonids has occurred for more than 15 years. Over this period, the number of fish passed annually has varied depending on availability and production program changes. Currently, up to 5,000 coho salmon and 300 fall Chinook salmon are passed if egg collection goals are projected to be met. All chum and pink salmon, and cutthroat trout are passed. Steelhead trout returning before March 1 are assumed to be hatchery stock and are used

for hatchery production. The weir is de-activated after March 1 to allow all of the wild steelhead trout to migrate upstream.

The weir has also acted as an impediment to downstream migration of juvenile salmonids and adult steelhead trout during some spring low flow conditions. To correct this deficiency, hatchery staff used Puget Sound and Coastal Washington Hatchery Reform Project funding in 2000 to construct a 3-foot-wide slot in the weir to concentrate water flow and facilitate downstream movement of juvenile and adult salmonids (View 1).

FISH HEALTH ISSUES

Returning adult fish may harbor large numbers of pathogens that are released into the environment with the eggs and fluids during spawning and from the carcasses during decomposition. This is probably the most significant period of pathogen transmission. A second period of high pathogen release may occur during hatching and emergence of the fry. If these activities occur above the water intake, infectious agents may be showered onto the juvenile fish in the hatchery. Relative risk depends on pathogen density, susceptibility of the hatchery fish to specific pathogens, and stream flow.

With low numbers of pathogens occurring in the water supply, control measures may be used within the hatchery to minimize the impact on the juvenile fish, frequently without the use of drugs and chemicals. Measures could include reduced rearing densities, pond manipulations, or more frequent carcass removal from intake grates. Maintaining a healthy fish population inside the hatchery with minimal use of drugs and chemicals is expected to have the least impact on aquatic populations downstream from the hatchery. If there is a large, highly infected, spawning population above the hatchery intake, juvenile fish losses may result even with the best management practices and with heavy use of approved drugs and chemicals.

The primary pathogens of concern in the Sooes River include *Renibacterium salmoninarum* (causative agent of bacterial kidney disease), *Flavobacter psychrophilum* (causative agent of bacterial coldwater disease), *Aeromonas salmonicida* (causative agent of furunculosis), *Ichthyophthirius multifiliis* (causative agent of Ich), and *Viral Hemorrhagic Septicemia* (VHS) virus. The pathogen that causes furunculosis is routinely isolated from both juveniles and adult fish and it has developed resistance to antibiotics approved by the Food and Drug Administration for use on food fish. In these cases the disease has been treated through the “Investigative New Animal Drug” or “extra label veterinary prescription” processes using other antibiotics.

Potential disease problems caused by passing infected adults upstream of the hatchery’s water supply have been discussed as a concern regarding an adult passage program. For example, a VHS detection in 1988 precipitated the complete de-population of juvenile salmonids at the Makah NFH in 1989. This extreme measure was taken because this was the first isolation of this virus in North American fish stocks and it was believed that containment of the disease was

paramount. While disease concerns still persist, fish health biologists realize that suitable habitat should be used for natural fish production. However, they may recommend modifications to fish hatchery operations to minimize the disease risk if an adult passage program is continued.

HABITAT and SALMONID FISH USE

The Sooes River originates in the foothills of the northwest slope of the Olympic Mountains. The river flows through timberlands owned by the Crown Pacific timber company until it reaches the Makah Indian Reservation boundary at about river mile (RM) 4.2 (Figure 1). All of the lands are managed for timber harvest.

The Sooes River mainstem length is about 16 miles. There are also approximately 39 miles of tributaries entering the Sooes River. However, there is an impassible water fall on the Sooes River at RM 13.8 and salmonids reportedly use only 14 miles of the tributaries (Washington Department of Fisheries (WDF) 1975)(Figure 1). There are no other known impasses to fish migration except for the hatchery weir itself during operation.

The Sooes River watershed is intensively managed for timber production within all ownerships. Major logging occurred during the 1970s. Consequently, most stands are less than 30 years old. Forest conifer composition is about 60% hemlock, 30% spruce, and 10% fir. Alder stands are common along the streams. The conifer harvest rotation period is 45 years, although thinning occurs between 25 and 30 years (Frank Silvernail, Crown Pacific Timber Company, per. comm., 2000).

Generally, habitat quality of Sooes River and its tributaries is poor. Large woody debris is uncommon and immediate natural recruitment potential is low because of past intensive logging practices in riparian areas. However, spawning gravels and riffles are abundant and are interspersed with resting pools. Riparian vegetation and canopy consist of young stands of alder and conifers (Views 2 and 3).

Observations made during a site visit by Service staff to the Sooes River watershed in October 2000 indicated a dynamic, mobile gravel bed with substantial bar development in some reaches (Paul Bakke, Service, per. comm., 2000). Observations of sediment structure in several spot-samples revealed a coarsened, but not embedded, gravel surface over a subsurface enriched with coarse sand but little or no fine sand or silt. This composition is generally easy for spawning fish to excavate and provides ample intra-gravel flow. However, it is also easily mobilized during high flows. Since there is little in-channel large wood to dissipate hydraulic energy, gravel bars are exposed to substantial hydraulic shear stress during floods, with concomitant scour and bar mobility. Also, the Sooes River probably experiences a “flashy” hydrologic pattern, providing high sediment transport capacity over brief, but frequent, floods. Mass wasting is also evident in some parts of the watershed, which results in substantial movement of fine and coarse sediment to downstream areas.

Except for the headwaters, the Sooes River gradient is less than 1% throughout its course and water temperatures generally average from 42° F (5.5° C) in January to more than 65° F (18.3° C) in August at the hatchery. Tribal staff believe that water temperatures are generally cooling as a result of improving canopy cover and riparian conditions (Mike Haggerty, Makah Nation, per. comm., 2000). Summer low flows typically fall to about 9 cubic feet per second at the hatchery (Al Jensen, Service, per. comm., 2001).

Habitat deficiencies in the watershed are being addressed. Currently, the Makah Nation is working cooperatively with Crown Pacific Timber Company to identify and replace problem culverts. Together they are experimenting with adding large wood to the Sooes River (View 4). Also, streamside buffer protection should, after a number of years, provide a source of large wood for stream enhancement.

Currently, coho salmon, fall Chinook salmon, fall chum salmon, and pink salmon, and steelhead and cutthroat trout use the Sooes River below and above the Makah NFH. One alleged bull/Dolly Varden trout was observed at the hatchery. However, the Sooes River does not provide optimum habitat for all bull trout life stages. Typically, water temperatures exceed bull trout spawning and incubation requirements.

The current adult salmonid passage program is producing significant numbers of salmonid smolts. In 1987, 793 mature coho salmon were passed upstream of the hatchery. As a result of the detection of *Viral Hemorrhagic Septicemia* virus in late 1988, a downstream weir was placed on the existing weir in the spring of 1989 to capture all downstream migrating smolts for subsequent burial. This was an extreme precautionary measure implemented to control the potential spread of this virus. Makah Nation staff estimated that more than 19,000 coho salmon smolts, originating from the 793 coho salmon passed in 1987, and several thousand steelhead trout smolts originating from the adults that passed the de-activated weir in 1987, were captured (Mark LaRiviere, Makah Nation, per. comm., 1989).

OPTIONS

Following are three options that could be considered, either individually or in combinations, regarding salmonid use of the habitat above Makah NFH: 1) adult passage, 2) juvenile planting, or 3) adult carcass distribution for stream/nutrient enhancement purposes. All three options are directed towards the Sooes River watershed above the hatchery. The river downstream of the hatchery is already being used by coho, chum, pink, and Chinook salmon, and steelhead and cutthroat trout.

Option 1: Adult Passage. The advantage of continuing the adult passage program is that all project objectives are accomplished. Additional freshwater salmon production contributes to all fisheries. Mate selection and subsequent juvenile survival experience “natural selection pressures.” Spent carcasses contribute to the ecology of the stream by providing flesh for aquatic and terrestrial organisms and

nutrients to the system during decomposition. There is some risk associated with infected adults shedding pathogens into the hatchery water supply.

In this option all species would be passed. A production parameter of 1.12 smolts produced per linear meter of stream (Baranski 1989) and a factor of 50 smolts produced per female (Tim Flint, WDF, per. comm., 1989) may be used to calculate the appropriate number of coho salmon to pass. The factor of 50 smolts produced per female was also substantiated during the out migrant trapping conducted in 1989 ($793/2=397$ females passed; $19,691 \text{ smolts}/397 \text{ females}=50$). The Makah Steering Committee established an escapement goal of 300 adult Chinook in 1985. Warren (1994) reported spring Chinook salmon spawning values of 33 to 43 adults per mile in various rivers. Assuming Chinook use mainstem areas for spawning, a stream length of about 11 ($13.8-3.0=10.8$), multiplied by 33 to 43 yields a Chinook escapement range of 363 to 473, similar to the mitigation requirement. All wild stock steelhead trout would proceed upstream after the weir is de-activated on March 1. Nearly all of the steelhead trout entering the Sooes River prior to this date are hatchery stock and are used for production purposes. All chum and pink salmon and cutthroat and bull/Dolly Varden trout would be passed as well.

Option 2: Juvenile Planting. The advantage in considering this option is the ability to plant specific pathogen-inspected fingerlings, minimizing fish health concerns that arise in an adult passage program. It would satisfy the objectives of increasing production from the additional freshwater environment and imposing natural selection pressures on a part of the population.

The objective of enhancing stream productivity through nutrient enhancement would not be accomplished. Access points to planting sites are limited.

Coho and Chinook salmon are the preferred species. The juveniles would experience natural selection pressures during their residence. A production parameter of 1.12 coho salmon smolts produced per linear meter of stream (Baranski 1989), a 7.3% coho salmon May fry-to-smolt survival factor (Scott Chitwood, Quinault Nation, per. comm., 1989), and approximately 25 miles of stream length may be used to calculate the appropriate number of juvenile coho salmon to plant. Also, in 1985, the Makah Steering Committee prescribed a Chinook salmon pre-smolt mitigation goal of about 110,000 in lieu of adult passage.

Option 3: Carcass Distribution. Carcass distribution would meet the objective of enhancing stream productivity and providing another food source to the ecosystem. It would not, however, actually be using the habitat for fish production and access points are limited. This option is not advantageous when compared to Option 1.

DISCUSSION and RECOMMENDATION

We recommend continuing the current adult passage program with adjusted numbers based on parameters presented in Option 1. However, we will exercise Option 2 for Chinook salmon (upstream plant of up to 110,000 presmolts) when adult returns are not large enough to meet the mitigation requirement of 300 adults. Option 1 meets all three stated objectives to optimize fish production, restore natural selection pressures, and to enhance stream productivity through nutrient enrichment.

Success from the program has been realized through observation of both spawning adult and out migrating juvenile salmonids in the Sooes River and tributaries (Mike Haggerty, Makah Nation, per. comm., 2000) (Service, site visit, 2000). Up to 1,610 coho salmon and 473 Chinook salmon from throughout the return will be passed above the hatchery when available. The sex ratio should be 50/50 and 4% of the males should be 2-year-olds (jacks), as recommended by Seidel (1983). Incorporation of jacks into the spawning population ensures that genetic material from across broods will be contributed to the offspring. All chum and pink salmon and cutthroat, bull/Dolly Varden, and wild steelhead trout will be passed upstream.

However, Service pathologists may recommend reducing or eliminating a passage program in-season if a "Regulated or Reportable Pathogen," as listed in the Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State (Northwest Indian Fisheries Commission and WDFW 1998), is isolated during routine sampling of returning adults. Also, passage may be stopped upon finding a non-endemic pathogen that would pose a significant threat to juvenile hatchery fish, as well as other fish populations in the watershed, as determined by Olympia Fish Health Center staff.

This program will not be exercised at the expense of hatchery production needs, commercial and sport harvest opportunities, nor the carcass distribution program to the Makah Nation. Carcasses not needed for scientific purposes are property of the Makah Nation by cooperative agreement. Typically, more coho and Chinook salmon return to the hatchery than are needed for production purposes, can be effectively harvested, or are distributed for human consumption.

Co-manager Contact

The initial adult passage program was developed by the Makah Steering Committee. The original committee included WDF and Makah Tribal representation. The WDFW has not participated in more than 10 years. Changes recommended to the original passage program will be communicated to co-managers via this report. We also received an internal Service "no effect" determination regarding impacts to listed bull trout with this fish passage option.

Program Evaluation

No specific program evaluation is proposed in the short term. However, as time and funding permit, we should evaluate the resulting smolt production and subsequent adult return from the adult passage program at Makah NFH.

An indication of program success may be realized through our coded-wire tagging and mass marking of hatchery production. Returning ratios of marked-to-unmarked fish may provide information on natural production associated with an adult passage program.

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